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Double dividend hypothesis: Can it occur when tackling carbon emissions?

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Abstract

The paper focuses on the double dividend hypothesis occurrence in case of carbon taxation enactment. Our assessment questions the conditional occurrence of the hypothesis, where environment improvement and the reduction of tax distortions depend not only on the design of carbon taxes but also on the complementary measures implemented to enhance their efficiency. This paper takes into consideration previous proposals to reduce labor taxation in order to strengthen double dividend hypothesis and aims to point out the risks of such measures, for they could endanger the process of pollution abatement. Due to this fact, the paper proposes another set of alternative measures to boost carbon taxation efficiency.

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Keywords: Carbon taxation; double dividend hypothesis; distortionary taxation; environment protection; income tax cuts

1. Introduction

This paper discusses the validity of double dividend hypothesis in a second best setting. It is based on previous studies which assess the double dividend hypothesis and analyze its applicability considered as a real output of carbon taxation enactment. Inductive theoretical analysis underlying this hypothesis is used, to highlight the necessary condition that should be met by abatement policy instruments in order to reach the two goals proposed by the double dividend hypothesis. It is considered that there is a strong relationship between the two effects of carbon

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taxation, namely the tax interaction effect and the revenues recycling effect, where we identify a causal relationship between the proposed double dividends as outputs of carbon taxation. Our assessment takes into consideration the primary purpose of carbon taxation introduction and it sustainability in a framework where a scheme of additional measures is implemented. We consider that in this context, the results of abatement policy depend on the efficiency of these complementary measures to balance the end-results in favor or against attaining a better environment protection and a less distortionary fiscal system. In order to support our assessment we perform an empirical analysis where we estimate the impact of the Environmental tax and Income tax receipts in 15 EU countries over the consumption of energy in the last 17 years. We assume that there is a unilateral influence between Income tax receipts and Environmental tax revenues, where a mechanism that aims a "tax swap" between the two levies will cause insignificant changes into demand for carbon intensive goods, such as energy consumption.

2. Literature review

The concept of double dividend, as an output of environmental levies, was assessed in a detailed form by Goulder (1995). The author inserts the central rationale of environmental economics – the Pigouvian theory into the real world economies. In this particular setting, getting the right price of carbon taxation enters a world of pre-existing distortionary fiscal system. Therefore, in author's assumption the environmental levies interact with other pre-existent distortionary taxes. This means that overall gross costs of carbon taxation are regulated by distortionary taxation. But, in the same time the author indicates the possibility of a "swap" between environmental taxes with other existent one. From here arises the concept of double dividend, meaning that environmental levies could pursue a double objective: pollution decrease and reductions of distortionary effects of pre-existent direct taxes. In Goulder's (1995) conception, the environmental taxation is labeled as a revenue neutral package that does not affect the revenues level collected to the public budget. One of the most significant assertions of the author is the fact that even if carbon taxation has revenue recyclation potential, with any given method of using these revenues, pre-existing taxes increase the costs of carbon taxation introduction. The author identifies two main effects of environmental taxes enactment: the tax interaction effect and the revenues recycling effect, where the former has a larger impact on overall gross costs than the latter. Goulder (1991) analyzes the theoretical background behind the double-dividend hypothesis and somehow predicts the need for a complementary action in order to validate the first dividend – the environment protection. Being preoccupied by environmental improvement, Goulder (1991) considers that theory is fixed upon the second dividend – economic efficiency, because the first one is highly uncertain. The idea of introducing costless green taxes that will not increase the burden of already existent distortionary taxes is very appealing. The first justification to enact carbon taxation is the positive sign of the environmental benefits.

The two effects of carbon taxation come in direct relation with double dividend hypothesis. However, these effects are sensible connected with the overall costs of new tax enactment and the attempt to neutralize the excess burden of this levy. The purpose of revenue-neutral package is to create a costless environmental policy which can be used not only to decrease the negative externalities of pollution but also to decrease the distortions from pre-existent fiscal system. Assuming from beginning that carbon taxation costs are zero or negative, this yields positive net benefits. But if one cannot be assured of zero costs, Goulder (1991) considers that the tax swap can be questioned due to the difficult if not impossible comparison between environmental benefits with abatement costs once carbon taxation is implemented.

Poterba (1991) considers that one of main objections attributed to the carbon taxation in developing countries is the "perceived regressivity" of excise duties, such as carbon tax. In this situation if a carbon tax would be enacted without any offsetting changes in other taxes or transfer programs, the burden will fall more heavily on low-income than high-income households. Metcalf (1998) analyses the distributional impact of a tax shift from direct distortionary taxes towards indirect environmental taxes in US. His findings show that a tax reform where a 10% of federal receipts attributed to environmental taxation have an insignificant impact over income distribution if revenues are returned to the households through income tax cuts. In this revenue-neutral package, the tax swaps has a negligible regressivity, with a minor effect over household income and its consumption patterns.

Goulder (1995) considers that the pollution tax affects the relative price of the consumer goods, distorting household consumption choice as well as its labor-leisure choice. Recycling the revenues restores the real wage to

its original value and thereby mitigates the labor-market distortions, but such recycling does not undo the change in relative consumer good prices and the associated "distortion" in consumption. For this reason the revenue-recycling effect only partly offsets the tax interaction effect where the level of abatement is non-incremental. The overall efficiency benefits from environmental taxes are lower than in the first best setting, because of the distortions or pre-existing direct taxes. Goulder (1995) considers that the presence or the absence of the revenue-recycling effect can determine the sign of overall efficiency impact. According to the author the tax interaction effect has a greater magnitude over gross costs than the revenues recyclation effect. In this case the tax rate should be below the Pigouvian principle.

The carbon taxation would reduce pollution by raising private cost with the amount of taxation, thus declining the pollution and in the same time collecting revenues. Direct distortionary taxation such as tax on income produce a burden on workers, whose net salary decreases with the amount of the tax on income, leaving less money to spend and decreasing the "availability" of workers to work more hours per day. The double dividend hypothesis states that carbon taxes could reduce the deadweight loss from pollution, increasing private cost thus decreasing pollution, but in the same time carbon taxes could, with the revenue collected, reduce some of the direct taxes, reducing the deadweight loss created by direct distortionary taxation.

In this case, arises the question whether the real wage will be bigger or smaller than those in the previous period once the income tax cuts are applied and carbon taxation is enacted.

The problem that arises is, if the real wage stays above the previous power of consumption, with higher net income in their incomes and expensive "dirty goods", which this time is more expensive. If real wage is smaller than previous one then the double dividend hypothesis does not apply and carbon taxation becomes another supplementary burden, which adds to the already distortionary fiscal system. Fullerton (1997) considers that the second dividend through reducing the distortionary effect and increasing the efficiency of fiscal system is to cut other taxes that are more distortionary than average.

When analyzing the double dividend hypothesis one should account for the use of revenues and the nature of pre-existing distortionary taxes, which could influence the size of carbon taxation costs. Environmental levies tend to produce a decrease of non-environmental welfare, less income to spend induce less products to consume. Goulder (1995) considers that distortions in commodity and labor market are connected. The behavior effect or the "tax base erosion effect" limits the capacity of environmental taxes to finance labor income tax cuts, increasing the overall social costs of abatement policy.

Jorgenson and Wilcoxen (1990) model finds that carbon tax enactment and the swap with capital income tax cuts will result in negative gross costs, yielding a positive gross welfare change. The basic partial equilibrium analysis of the optimal environmental tax invokes the Pigovian Principle: the optimal carbon tax is at a rate equal to the marginal external costs, or marginal environmental damages (hereinafter as MED). This principle implicitly assumes that the carbon taxation gross marginal cost or marginal abatement cost (hereinafter MAC) is associate with an environmental tax is equal to the tax rate. Hence if the tax is set equal to the MED, gross costs and environmental benefits will be equated at the margin, assuring optimality. In a second best setting, a carbon tax will give rise to the marginal gross costs that differ, usually higher than the tax rate. In this situation, the revenue replacement effect tends to reduce the gross costs, it tends to imply a higher optimal tax rate that is above MED. But in the same time the tax interaction effect tends to raise the gross costs which imply an optimal tax rate bellow MED.

A central question, which is critical to the double dividend hypothesis is whether the revenues recycling effect is strong enough to outweigh the tax interaction effect? The answer also determines the relationship between the optimal tax rate and the marginal environmental damages.

The double dividend hypothesis validity has been closely assessed by Lee and Misiolek (1986), where the authors require that the difference between the marginal abatement costs and marginal environmental benefits per marginal unit of revenues must be equal to the marginal excess burden of existing distortionary taxation. Carbon taxation enactment in a second-best setting encounters the problem of contradictory costs issue or how to establish an optimal environmental tax in case of pre-existing distortionary tax system.

Bovenberg and de Mooij (1994) consider that an incremental environmental tax, with revenues returned to the households as labor tax cuts will have zero gross costs. When the tax rate is small, meaning is less than MED, it yields the same labor market distortions as the labor tax it replaces, and the gross distortion is infinitesimal. Fullerton and Wolverton (1997) emphasizes the need for half-reforms when a state is implementing a carbon tax.

There is a demand for continuation, where the revenues should be strategically destined to proper use as supporting carbon abatement policy. Fullerton and Metcalf (1997) asses the double dividend hypothesis, where they argue the two kinds of benefits that might result from carbon taxation on pollution. First benefit represents the improvement of the environment and the second one represents an improvement in economic efficiency by using the revenue from imposition of carbon taxes to cut other distortionary taxes as labor tax.

In order to avoid the offsetting effect between carbon tax and income tax cuts, which would have the same impact over real net income, Fullerton and Metcalf (1997) consider in this case, that the second dividend can be obtained only if the state decides to operate upon other categories of taxes like capital or profit tax.

Carbon tax enactment face challenges due its regressive nature. By imposing carbon taxes and thus raising the prices of inputs, it cannot be simply assumed that the companies will automatically shift their production towards more environmental friendly technologies. In this situation it is needed to distinguish between statutory incidence (the legal tax imposed on a subject: company, household, individual consumer) and economic incidence (entity which really bears the burden of the new tax imposed). The desired behavior is based on increased prices of goods and services which are subjected to environmental tax, and thus an expected response will be a reduction of the consumption of such commodities.

The degree of behavioral changes depends on the availability and the price of the substitutes. Goulder (1998) through his general equilibrium model demonstrates that carbon taxes will increase prices on conventional fuels industry and that those higher prices would lead to higher demand for alternative fuels trough substitution effect. Goulder (1998) states that the elasticity response to carbon tax and mitigation programs is enhanced if induced technology change (hereinafter as ITC) is present. The author concludes that the presence or absence of revenue recycling coupled with carbon taxation can fundamentally affect the overall efficiency impact of abatement policy. When marginal benefits from abatement policy fail to exceed certain threshold value, pollution policies that do not use revenue recycling are unable to produce any efficiency improvement on environment protection, no matter the size of pollution abatement.

3. Methodology

Carbon tax enactment analysis in a second-best setting should take into consideration a complex set of social costs and benefits. The efficiency of this environmental levy depends on the laborious comparison between *a priori* set of social costs such as pollution costs and *a posteriori* social costs of carbon tax introduction. Correspondingly, setting the right price for carbon emissions requires the comparison between social benefits from carbon intensive goods and the social benefits that arise from the avoided damages of environment, due to the carbon taxation enactment. Additional measures that would enhance carbon taxation efficiency are needed to narrow the interaction effect between carbon tax and other distortionary direct taxes. However, beside this interaction effect, carbon tax exerts pressures on labor market due to the price increase of commodities, affecting not only labor supply but also labor demand and investment.

The revenue-recyclation effect proposed by Goulder (1994) aims to decrease the distortionary impact on the after-tax wage, which increases budget constraint which distorts the labor market, where individuals will choose more leisure time and fewer working hours per day.

As shown in the previous section, the primary studies support the idea that carbon taxation should offset the distortionary impact of direct taxes. Although income tax cuts might be appealing, this mechanism risks to become a hidden subsidy from the state to individuals. Leaving the real net income unaffected after price increases, due to the income tax cuts via environmental taxation, this mechanism unintendedly further allows individuals to buy now more expensive “dirty goods”. In this particular case, consumption patterns remain unchanged. Making a tax-rebate, exemptions or labor tax cuts becomes a reverse of carbon taxes and increases the consumption of carbon intensive products. This means that the state, through income tax cuts, subsidizes the consumption of the same goods that previously have been taxed (for its amount of carbon emissions resulted in the production process). This reversal of abatement policy does not improve environment and certainly does not reduce pollution.

The Figure 1 presented below aims to underline the vicious spiral into which carbon taxation risks to fall if appropriate additional measures are not implemented. Taking into consideration the fact that own-price and income

elasticity of demand for fossil fuels is inelastic, the burden of taxation will be carried mostly by the consumers and not by the companies.

If the state targets the neutrality of carbon taxation through income tax cuts, this measure could yield undesired outcomes. If we considered the demand inelastic, the burden of taxation (t) can be easily shifted towards consumers through price mechanism ($\boldsymbol{t_1}$) is greater than ($\boldsymbol{t_2}$). In this case, income tax cuts leave the real income unaffected (identical budget constraint curve), which means that the impact over the "dirty goods" is unchanged and pollution will not decrease.

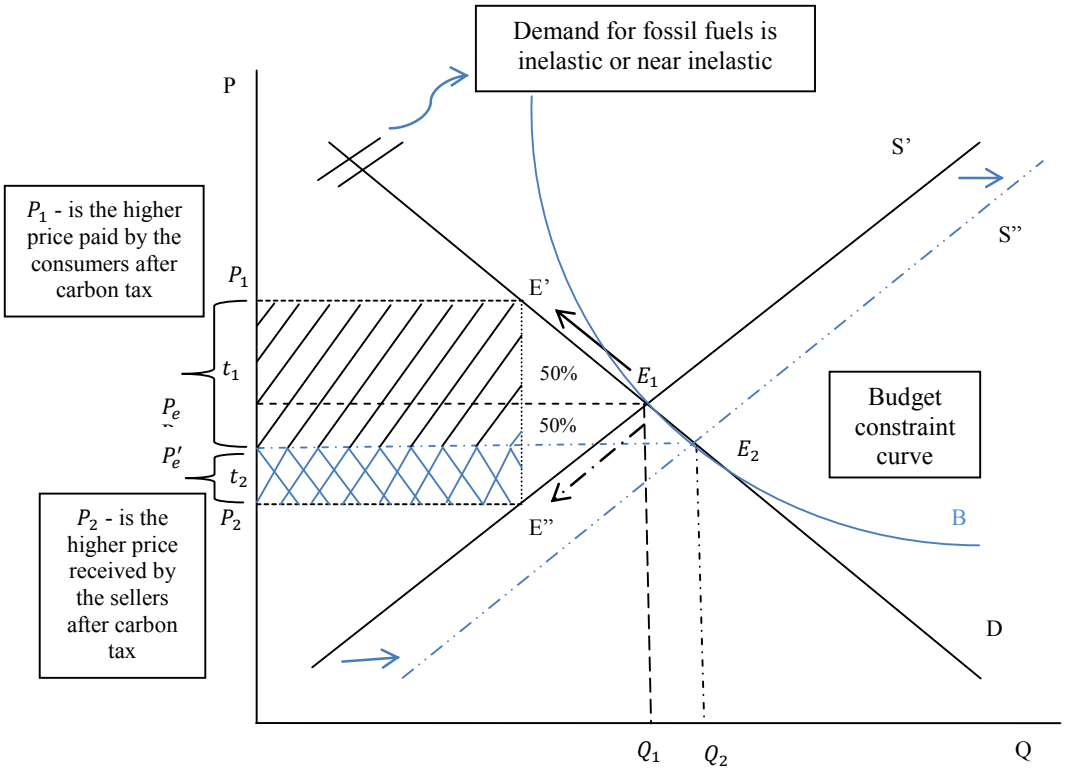

Fig.1. Tax impact on supply and its displacement in a framework where there are offsetting measures (such as income tax cuts).

In order to justify the necessity of compensation that should be enacted together with carbon taxation, one could use the analogy to the laws that govern the demand and supply (of fossil fuels). Firstly, one should note that the main visible impact of taxation will be the increase of price on related goods (fossil fuels and carbon intensive goods and services). It means that carbon taxation will imply modifications of price- the state will achieve only movements along the demand and supply curve for fossil fuels, assuming other variables are *ceteris paribus*.

Secondly, shifts in the demand and supply of fossil fuels are determined not only by price modification but also by the prices of other goods considered as substitutes. Compensation granted to the pollutant agents, as a consistent instrument with the carbon taxation, creates incentives that will boost the production of substitutes (less carbon intensive goods, green sources of energy). There is a strong interrelation between taxation and compensation, where the former acts as an excise increasing the price and stressing the consumption behavior but also provides the needed for financial resources to support the latter which creates the incentives and the framework for alternatives that would gradually replace the consumption of "dirty goods" with the green ones.

4. Results

Taking into the consideration the tax-interaction effect, we analyze the validity of this effect at the EU countries level, where we test the relation between income tax revenues and environmental tax revenues using Granger Causality test. The empirical analysis is performed on a panel data set, for a number of 15 European Union countries, in the period of 1995–2011. The data source is Eurostat. Granger Causality test is performed in order to show the causal determination between the two variables, in this particular situation to identify if the two effects (tax-interaction effect and revenue-recycling effect) of environmental taxation implementation occurs.

Table 1. Granger Causality result between Environmental tax revenues and Income tax revenues

Pairwise Granger Causality Tests Null Hypothesis:	Obs	F-Statistic	Prob.
INCOME2 does not Granger Cause ENV2	210	6.01822	0.0029
ENV2 does not Granger Cause INCOME2		0.29805	0.7426

Source: Own calculation.

The results of Granger test shows that there is only a unilateral causal determination, where Granger causality runs only one-way from Income tax (INCOME) to Environmental tax (ENV), and we fail to reject the null hypothesis where Environmental tax receipts (ENV) have a causal determination on Income tax receipts (INCOME). This result confirms the tax-interaction effect stated by Goulder (1994), where the author sustains that the overall gross costs of environmental levies will be increased through tax interaction with other pre-existent distortionary taxes. The absence of a bilateral causal determination between the two variables rejects the occurrence of revenues-recyclation effect and therefore invalidates the second dividend of the double dividend hypothesis.

One pertinent argument that would sustain the absence of revenues-recyclation effect and thus exclude the second dividend is due to the uneven and scattered abatement policies across EU countries. In most of these countries, environmental taxation is not accompanied by equivalent tax reductions (for example income tax cuts).Further, we focus our empirical analysis on panel data in order to estimate the impact of Environmental tax and Income tax receipts on the Energy consumption in 15 EU countries, in the period 1995–2011. The data sets are provided by Eurostat. Our aim is to estimate the impact of the two tax receipts on the demand of energy in EU in the last 17 years. The independent variables Environmental tax revenues (ENV) and Income tax revenues (INCOME) are expressed in millions Euro and the dependent variable Final consumption of energy is expressed in thousands tons of oil equivalent. The regression equation is:

$$\boldsymbol{Energy_{i,t} = \alpha_{i,t} + \beta_1 (ENV_{i,t}) + \beta_2 (INCOME_{i,t}) + \varepsilon_{i,t}} \quad (1)$$

Classical multiple regression equation assumes that an explanatory variable has an impact on the dependent variable while other terms are constant. However, we introduce this interaction term to test the influences between independent variables and estimate their impact on the dependent variable in this particular setting. Given the result obtained from the Grange Causality test above, we insert an interaction term between the two independent variables. This procedure allows to explore the whether one independent variable (INCOME) influences the impact of a second independent variable (ENV) on the dependent variable (Energy). The regression equation with an interaction term is:

$$\boldsymbol{Energy_{i,t} = \alpha_{i,t} + \beta_1 (ENV_{i,t}) + \beta_2 (INCOME_{i,t}) + \beta_3 (INCOME * ENV_{i,t}) + \varepsilon_{i,t}} \quad (2)$$

The generation of interaction term is performed through multiplication of the two independent variables. Even if the coefficient obtained by this third explanatory variable is negligible, it is important to mention is the p-value

obtained and also the coefficient from the primary independent variables when the interaction term is introduced into regression.

The results obtained estimating equation (1), where the interaction term is excluded, show that ENV has no statistical significance over the demand of energy in the analyzed EU member states. However, Income tax revenues (INCOME) have a positive impact on the demand for energy.

In order to test if there is a tax-interaction effect, we estimate equation (2), where an interaction term between the two independent variables is introduced. The interaction term inclusion in equation (2) modifies substantially the statistical significance of the Environmental tax revenues (ENV) and also changes the coefficients of the both independent variables.

Table 2. Multiple regression results

Dependent Variable: ENERGY		
	(1)	(2)
α	61041.63 [1525.284] (0.0000)	45285.12 [1991.439] (0.000)
β_1	−0.15321 [0.155782] (0.3264)	0.8625 [0.16316] (0.000)*
β_2	0.072027 [0.01916] (0.0002)*	0.2869 [0.026257] (0.000)*
β_3		−5.8106 [2.6507] (0.000)*
R-squared	0.897046	0.99573
Adjusted R-squared	0.896835	0.99544

Source: Own calculations. [] – Standard errors; () – *p*-values; * – Statistically significant at the significance level of 1 %.

The results presented in the Table 2, show that firstly there is an influence between INCOME and ENV, confirming the results obtained in Granger causality test, where p-value for $\boldsymbol{\beta_3}$ rejects the null hypothesis. The estimation results for $\boldsymbol{\beta_1}$ **and** $\boldsymbol{\beta_2}$ support our argument which considers that if revenue recyclation will imply income tax cuts along carbon tax enactment, this mechanism of restoring the individual income will leave real wage unaffected. Consequently, in this particular case, where real wage is unaffected but the price of carbon intensive goods has increased due to the carbon tax, for example energy, the individuals will follow the same consumption pattern. The sign of $\boldsymbol{\beta_1}$ **and** $\boldsymbol{\beta_2}$ coefficients shows that changes in both independent variables (Environmental and Income tax receipts) had a positive impact over the consumption of energy. Relating these results to the double dividend hypothesis we can argue that an inopportune additional measure as part of recycling –revenues effect in order to diminish the tax-interaction effect will invalidate the first dividend of abatement policy – environment protection. Pursuing offsetting measures to narrow the regressivity of carbon taxation through income tax cuts, the state gives indirectly subsidies to the individuals to afford now more expensive carbon intensive goods. What did the literature by focusing insistently upon tax-interaction effect and the need to decrease gross costs of carbon taxation is to forsake the primary goal of environmental levies turning them in another tool to collect revenues to the public budget.

5. Conclusion

Carbon taxation, seen as central tool of abatement policy incorporates the advantage of revenue creation. This feature of environmental levies has a leverage potential, which can be used to enhance carbon taxation efficiency.

However, if one omits to take into account the impact of revenue recyclation effect on pollution, then this mechanism risks to undermine the abatement policy goals achievement.

The aim of the paper was to analyze the double dividend hypothesis validity when a tax-interaction effect is narrowed through a tax shift. We consider that income tax cuts, as offsetting measures to compensate the excess burden of carbon taxation, will have a negative impact on environment protection. It is important to mention that the second dividend – a less distortionary tax system through income tax cuts, will suppress the first dividend – environment protection. The results obtained from the empirical analysis do confirm our argument, where environment taxation in EU countries, in the last 17 years, increased the consumption of energy. In exchange to income tax cuts as a mechanism to decrease the gross costs of carbon tax, we propose other distortionary tax cuts, such as capital or payroll taxes cuts. These additional measures seen as a form of compensation bear the capacity to offset the overall costs of carbon taxation enactment, incentivizing alternative environmental friendly goods production and consumption.

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